

# Knowledge level on imaging exams protocols in pediatric dentistry: a cross-sectional study with questionnaire

## O conhecimento da indicação de exames por imagem na odontopediatria: um estudo transversal com questionário

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#### RESUMO

Este estudo teve como objectivo avaliar o nível de conhecimentos dos estudantes de Odontologia, que já frequentaram os cursos de Radiologia Dentária e de Criança Materna 1 na Universidade de Caxias do Sul em Maio de 2020, sobre as prescrições e protocolos adequados de diferentes exames de imagem na sua prática clínica diária. Materiais e Métodos: Foi desenvolvido um questionário utilizando a plataforma online Google Forms e dividido em diferentes sessões: a) informação pessoal; b) prescrição de TCFC; c) conhecimentos específicos dos estudantes relativamente a imagens de TCFC; d) prescrição de técnicas de radiografia dentária; e) diagnóstico por imagem; f) dose de exposição; g) cuidados com a proteção contra a radiação tanto do profissional como do paciente durante o tempo de processamento das radiografias convencionais. Cinquenta e seis participantes receberam o formulário por correio electrónico. Resultados: Relativamente à TCFC, 66,6% dos inquiridos já a utilizaram, e 91,6% acreditam que é essencial ter acesso fácil a esta tecnologia. Enquanto 37,5% declararam ter um conhecimento profundo das principais terminologias, 66,67% declararam que raramente prescrevem TCFC. Relativamente à proteção contra radiações, 97,92% dos inquiridos afirmaram usar um avental de chumbo para assegurar a proteção dos doentes; no entanto, 23% dos aventais não incluem um escudo da glândula tiróide. Quanto à sensibilidade dos filmes radiográficos, 50% dos inquiridos utilizam filme radiográfico F. Conclusão: Assim, descobrimos que existe uma falta de conhecimentos específicos sobre exames de TCFC e sobre filmes radiográficos convencionais entre os cirurgiões dentários.

**Palavras-chave:** Odontopediatria; Radiologia; Dose de radiação; Tomografia computadorizada de feixe cônico.

#### ABSTRACT

This study aimed to evaluate the knowledge level of Dentistry students, who have already taken the Dental Radiology and Maternal Child 1 courses at the University of Caxias do Sul in May 2020, on the appropriate prescriptions and protocols of different imaging exams in their daily clinical practice. **Materials and Methods:** A questionnaire was developed using the Google Forms online platform and divided into different sessions: a) personal information; b) prescription of CBCT; c) students' specific knowledge regarding CBCT images; d) prescription of dental radiography techniques; e) imaging diagnostics; f) exposure dose; g) care with the radiation protection of both the professional and the patient during processing time for conventional radiographs. Fifty-six participants received the form by email. **Results:** Regarding CBCT, 66.6% of the respondents have already used it, and 91.6% believe that it is essential to have easy access to this technology. Whereas 37.5% declared thorough knowledge of the main

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terminologies, 66.67% stated that they rarely prescribe CBCT. Regarding radiation protection, 97.92% of the respondents said they wear a lead apron to ensure patients' protection; however, 23% of the aprons do not include a thyroid gland shield. As for the sensitivity of radiographic films, 50% of the respondents use radiographic film F. **Conclusion:**Thus, we found that a lack of specific knowledge on CBCT examinations and on conventional radiographic films exists among dental surgeo.

**Keywords:** Pediatric dentistry; Radiology; Radiation dose; Cone-beam computed tomography.

#### **INTRODUCTION**

Dental imaging examinations are useful complementary methods during the diagnostic process in dental treatments for children. Despite their low radiation dose, those examinations can invariably lead to the release of free radicals with possible damage to patients (HEDESIU et al., 2018). Moreover, some patients are submitted to several investigations within a short period of time, mainly in cases of dento-alveolar trauma (APS, 2013).

In this sense, ionizing radiation is often considered harmless because it is carried out on devices with reasonably low kilovolts. However, some important international organizations, such as the International Commission on Radiological Protection, the United Nations Scientific Committee for the Effects of Atomic Radiation, the United Kingdom's Radiological Protection Division, the U.S. National Council on Radiation Protection and Measurements are constantly monitoring radiation risks. They unanimously agree that even imaging examinations with low-energy radiation have stochastic effects that invariably present a potential risk (APS, 2013).

Regarding child care, dental surgeons must be significantly more careful about unnecessarily exposing young individuals to radiation and be aware of the three basic principles of protection against ionizing radiation: the principle of justification, by which imaging exams should be performed only if fully justified; the optimization principle (ALARA), meaning that the imaging exams should be performed using the lowest possible radiation dose provided that a satisfactory quality of image visualization is ensured; the principle of dose limitation, by which the maximum permissible doses to both professionals and patients should be strictly observed ((APS, 2013).

The recommendation for Cone-Beam Computed Tomography (CBCT), set by joint studies in Italy and Japan in 1998, brought a new perspective on the threedimensional images in the head and neck region (STRATIS et al., 2019). CBCT is based on volumetric computed tomography enabling the visualization of images in three dimensions: sagittal, coronal and axial planes, which allows a real visualization of the anatomical structures to be diagnosed. However, this three-dimensional examination provides a relatively high radiation dose compared to conventional dental radiographic techniques (HAJEM et al., 2020). Because of this, such an examination should be cautiously and properly prescribed in the different dental specialties in order to assist in the diagnosis, without causing damage to both the professional and the patient. Some of the indications include: dental and skeletal malocclusions (MARCU et al., 2018), evaluations of impacted teeth, dental resorption (HIDALGO RIVAS et al., 2015) and for performing corrective surgeries, such as orthognathic and cleft palate (HIDALGO RIVAS et al., 2015).

Due to the high amount of ionizing radiation in this advanced imaging exam type, different guidelines have been recommended by the scientific world. SEDENTEX CT aims at the safety and efficacy of this new imaging technology, suggesting that CBCT exams be recommended for clinical situations where the information provided can help diagnosis and treatment decisions. Likewise, the American Academy of Oral and Maxillofacial Radiology has revealed the effectiveness of CBCT for dental anomalies and treatment planning for moderate and severe skeletal discrepancies (HEDESIU et al., 2018). Therefore, the use of this technology in pediatric dentistry is justified in cases where the benefits clearly outweigh the risks to the patient (VAN ACKER; MARTENS ; APS, 2016).

Children and young adults are three to five times more sensitive than adults to radiation-induced carcinogenesis. In addition, the intercellular effects of ionizing radiation are cumulative and might lead to the development of tumors, such as, for example, intracranial meningioma and thyroid cancer (JACOBS et al., 2018). The patient's age is an important factor to be considered regarding the response to radiation exposure. While cure is typically faster in younger patients because of their higher reserve of tissue, the risk of damaging effects might increase in those patients because they have a greater amount of developing normal tissue (WAGNER;EIFEL;GEISE,1994; VASSILEVA; STOYANOV, 2010).

Therefore, the effective dose of radiation exposure should not be underestimated, especially in children, who are much more susceptible to stochastic biological effects.

Moreover, the thyroid protector must be invariably used as that organ is one of the most radiation-sensitive organs (KHONG et al., 2013; APS, 2013).

Owing to all of the above identified aspects, the present study aimed to evaluate, using a questionnaire, the knowledge level of Dentistry students, who have already taken Dental and Maternal-Child Radiology 1 programs, on the prescriptions and protocols of the various imaging exams in their clinical practice.

## MATERIAL AND METHODS Data Survey

After approval of the project by the Ethics Committee of the University of Caxias do Sul (UCS), under number CAAE 22005019.2.0000.5341, a questionnaire was jointly prepared by a pediatric dentist, a dental radiologist, and an undergraduate student of the UCS School of Dentistry. The questionnaire aimed to identify the knowledge level of dentistry students, who had already taken the Dental Radiology and Maternal-Child programs, on radiation protection in children, using both conventional and digital radiographic exams and CBCT images. The students were selected through the university's virtual environment, and the inclusion criterion was to have finished the two subject-matters aforementioned. The questionnaire was sent to fifty-six selected participants' e-mail addresses and remained available for reply for thirty days in May 2020. Forty-eight participants responded to the survey. At the end of the given period, the survey data were tabulated on a Microsoft Excel spreadsheet and analyzed descriptively.

The questionnaire, developed using the Google Forms online platform, was divided into different sessions: a) personal information; b) prescription of CBCT in clinical practice; c) professionals' specific knowledge in relation to CBCT images; d) prescriptions of dental radiography techniques; e) imaging diagnostics; f) exposure dose; g) care with radiation protection of the professional and the patient, processing time of the radiographs in the darkroom fluids (questionnaire attached).

#### **Data and Results Analysis**

Regarding the analysis of the research participants' personal data, it is observed that the average age was 24.87 years. Of these, 83.33% were female, 14.58%, male while 2.08% of participants preferred not to disclose their gender.

Table 1 shows the percentages of the responses concerning the students' knowledge level on CBCT. Sixty-six percent of the respondents have already used CBCT, and 91.6% state that it is essential to have easy access to this technology. Regarding the advantages of digital dental systems, 53% of the respondents aim at the lowest radiation dose. In addition, Figure 1 displays the participants' knowledge level of the most common CBCT terminologies (37.5% report fully knowing the main terminologies) and the frequency of CBCT prescription (66.67% rarely prescribe it).

Questions	Answers	
USE OF CBCT		
Have you ever used CBCT for diagnostics?		
Yes	66.6%	
No	33.3%	
Maybe	-	
Do you think it is important to have easy access to CBCT at your place of work?		
Yes	91.6%	
No	-	
Maybe	8.3%	
Advantages of CBCT		
Regarding digital systems, what is the greatest advantage of digital systems over		
conventional ones in pediatric dentistry?		
Speed	17%	
Radiation dose	53%	
Environment	2%	
Image quality	19%	
Others	8.5%	

Table 1	– Use and	Advantages	of CBCT
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Table 2 shows the prescription percentages of intraoral radiographic exams (48.9% prescribe periapical radiographs once a day; 51%, interproximal radiographs once a week; 80.8% rarely prescribe occlusal radiographs) and extraoral radiographs (46.8% prescribe PR once a month, 51% rarely prescribe cephalometric radiography, and 59.5% never prescribe radiograph of hand-wrist), respectively.

 Table 2- Frequency of intraoral and extraoral radiographs prescription

Questions	Answers
FREQUENCY OF INTRAORAL RADIOGRAPHS PRESCRIPTION	
How often do you prescribe periapical radiographs?	
Once a day	48.9%
Once a week	36.1%
Once a month	2.1%
Rarely	2.1%
Never	-
Others	10.6%
How often do you prescribe interproximal radiographs?	
Once a day	34%
Once a week	51%
Once a month	6.3%
Rarely	-
Never	-
Others	8.5%
How often do you prescribe occlusal radiographs?	
Once a day	-
Once a week	2.1%

Once a month	2.1%
Rarely	80.8%
Never	12.7%
Others	2.1%
FREQUENCY OF EXTRAORAL RADIOGRAPHS PRESC	RIPTION
How often do you prescribe a panoramic radiograph?	
Once a day	2.1%
Once a week	21.2%
Once a month	46.8%
Rarely	25.5%
Never	-
Others	4.2%
How often do you prescribe lateral teleradiography?	
Once a day	-
Once a week	-
Once a month	-
Rarely	51%
Never	46.8%
Others	2.13%
How often do you prescribe hand-wrist radiographs?	
Once a day	-
Once a week	-
Once a month	2.1%
Rarely	31.9%
Never	59.5%
Others	6.3%

Table 3 shows the response rate of the diagnostic imaging chosen by the professionals as complementary exams to the clinical examination of pediatric patients. Cases of post-traumatic fracture (78.7% periapical radiography), sinuses disorders (76.6% CBCT), endodontic purposes (100% periapical radiography), analysis of cysts and tumors (74.4% PR, 82.9% CBCT), pathologies of the temporomandibular joint (89.3% CBCT) were individually specified.

Table 3 -	Diagnostic	Imaging.
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PRESCRIBING IMAGING EXAMINATIONS <sup>2</sup>	
Cases	Answers
Post-trauma fracture	
Periapical	78.7%
Interproximal	2.1%
Panoramic	42.5%
Occlusal	21.2%
Teleradiography	4.2%
Hand-wrist	4.2%
Water's view or PA radiograph	-

<sup>&</sup>lt;sup>2</sup> Note: Regarding TMJ analysis, 12.6% prescribe MRI as the preferred examination. As for sinuses disorders, cysts and tumors, 2.1% refer them to a fellow dentist.

CBCT	70.2%
Nasal and sinuses disorders	
Periapical	-
Interproximal	-
Panoramic	31.9%
Occlusal	8.5%
Teleradiography	6.3%
Hand-wrist	-
Water's view or PA radiograph	57.4%
CBCT	76.6%
Endodontic purposes	
Periapical	100%
Interproximal	2.1%
Panoramic	4.2%
Occlusal	-
Teleradiography	2.1%
Hand-wrist	-
Water's view or PA radiograph	-
CBCT	34%
Cysts and tumors	
Periapical	19.1%
Interproximal	-
Panoramic	74.4%
Occlusal	19.1%
Teleradiography	2.1%
Hand-wrist	-
Water's view or PA radiograph	-
CBCT	82.9%
ATM analysis	
Periapical	-
Interproximal	-
Panoramic	31.9%
Occlusal	-
Teleradiography	19.1%
Hand-wrist	-
Water's view or PA radiograph	-
CBCT	89.3%

Furthermore, analyses of the students' knowledge regarding radiation doses of the different examinations performed in dentistry (periapical radiograph, CBCT and Fan Beam Computed Tomography-FBCT) with different protocols on CBCT images (small, medium and large fields of view) showed that the most frequent response was "I don't know", ranging from 64.5% to 87.5% (Table 4).

 Table 4 – Knowledge level of radiation doses.

KNOWLEDGE LEVEL OF RADIATION DOSES	
Questions	Answers
How many periapical radiographs (full mouth) are equivalent to a CBCT dose (Small	
field of view)?	
I don't know	64.5%
One	-
3-6	6.2%
10	8.3%
25	8.3%
35	4.1%
50 or more	8.3%
How many panoramic radiographs are equivalent to a CBCT dose (Small field of	
view)?	
I don't know	70.8%
One	-
3-6	16.7%
10	10.4%
25	2%
35	-
50 or more	-
How many fan beam CBCT examinations are equivalent to a CBCT dose (Small field	
of view)?	
I don't know	87.5%
One	-
3-6	8.3%
10	2%
25	-
35	-
50 or more	2%
How many periapical radiographs (full mouth) are equivalent to a CBCT dose	
(Medium field of view)?	
I don't know	81.2%
One	-
3-6	4.1%
10	6.2%
25	4.1%
35	2%
50 or more	2%
How many panoramic radiographs are equivalent to a CBCT dose (Medium field of	
view)?	
I don't know	72.9%
Une Concentration of the second secon	-
3-6	14.5%
10	8.3%
25	2%
35	2%
50 or more	-
How many fan beam CBCT examinations are equivalent to a CBCT dose (Medium field of view)?	
I don't know	85.8%
One	2%
3-6	4.1%
10	4.1%
25	2%
35	-
50 or more	2%
How many periapical radiographs (full mouth) are equivalent to a CBCT dose (Large	
field of view)?	

I don't know	68.7%
One	-
3-6	-
10	10.4%
25	4.1%
35	2%
50 or more	14.5%
How many panoramic radiographs are equivalent to a CBCT dose (Large field of	
view)?	
I don't know	75%
One	-
3-6	4.1%
10	12.5%
25	4.1%
35	4.1%
50 or more	-
How many fan beam CBCT examinations are equivalent to a CBCT dose (Large field	
of view)?	
I don't know	83.3%
One	2%
3-6	6.2%
10	2%
25	2%
35	2%
50 or more	2%

Finally, regarding radiation protection in infant patients, 97.92% of the respondents declared that they use a lead apron in their clinical practice (Figure 2). As to the radiographic processing time, 50% responded correctly with regards to the developer while 85.4% did so about the fixer. Regarding radiographic film sensitivity, 50% of the respondents declared that they use radiographic film type F.



Figure 2 - Use of radioprotection equipment

#### DISCUSSION

Source: Authors 2022

Although dental radiography exams offer a low dose of radiation, they are often used in the everyday dental clinical practice. In addition, recently, the use of CBCT has increased in the child population requiring greater attention and care in order to ensure good radiation protection (HEDESIU et al., 2018).

In this study, the majority of participants reported having already prescribed CBCT for clinical diagnoses. However, only 37.5% of the respondents reported full knowledge of the terminologies used in this imaging examination, such as Voxel, FOV, multiplanar reconstructions and DICOM images. Thus, we infer that the lack of knowledge of the terminology, such as Voxel and FOV, leads students and professionals of Pediatric Dentistry to unintentionally disregard a request for specific protocols that might provide proper protection for the infant patient (LAVANYA et al., 2016)

A study by Lavanya et al. (2016) found that most of the respondents felt the need for CBCT in dentistry to investigate the following specific cases: relation of third molar roots and the mandibular canal, mandibular and maxillary fractures, placement of dental implants, sinuses disorders, cysts and tumors, TMJ pathologies, and orthognathic surgeries. In the present study, most respondents were unaware of the equivalence of the CBCT exposure doses (small, medium and large FOV) compared to other imaging techniques, such as intraoral radiography, PR, and FBCT. A similar result was found in the study by Lavanya et al. (2016), in which the majority of respondents were unsure about CBCT exposure doses when compared to other types of imaging exams (LAVANYA et al., 2016).

Calculations performed using reference values defined by Li (2014) and Jadu et al. (2018), have shown that a small FOV CBCT is equivalent to 164 intraoral radiographs and 11.2 panoramic radiographs. A large FOV CBCT is equivalent to 318 intraoral and 21.7 panoramic radiographs. Thus, it is essential that professionals be updated and that basic radiation protection guidelines be widely distributed to dental surgeons so as to ensure protection against unnecessary ionizing radiation to pediatric patients (LI,2014; JADU et al., 2018).

In this study, 97.9% of participants said they use a lead apron to protect their patient from radiation; however, 22.9% of these shields do not include a thyroid collar. According to Li (2014), a thyroid collar is effective for protecting the gland in an intraoral region. When the shield was used in the anterior neck, the effective dose in the thyroid gland and esophagus was reduced to 15.9  $\mu$ Sv (reduction of 48.7%) and 1.4  $\mu$ Sv

(reduction of 41.7%) respectively. One cannot neglect the use of thyroid shields in conjunction with a lead apron as the effects of stochastic doses can be fatal for children in the future (LI, 2014).

A lead thyroid shield shall be used in cases in which the gland is in line or very close to the primary beam; in addition, the shield must be precisely positioned. Exclusively for CBCT exams, lead glasses, thyroid collars and rectangular collimation might minimize the dose for organs that are out of sight (TSAPAKI, 2017).

In our study, half of the participants responded that the main advantage of digital systems over conventional imaging methods is the radiation dose. However, as aforementioned in this study, despite all of the benefits, CBCT is associated with a higher radiation dose than conventional radiographic exams (intraoral and extraoral radiographs), however lower when compared to FBCT. Therefore, the radiation risk shall be assessed and quantified with an accurate calculation of effective dose, which is a quantity of radiation proposed by the International Commission for Radiological Protection (THEODORAKOU et al., 2012).

Moreover, 31.2% of the participants said they did not know which radiographic film they used in their exams. The International Commission for Radiological Protection has proposed a single, reduced dose in children when it is necessary to carry out conventional radiographic techniques, suggesting the use of films with higher sensitivity that require a lower dose of radiation. Such conduct can also protect patients against an excess of unnecessary ionizing radiation (HEDESIU et al., 2018).

#### CONCLUSIONS

Drawing upon the data obtained, it may be stated that CBCT prescriptions are not frequent in the pediatric dental clinical practice, but dental professionals lack specific knowledge of this exam as well as its proper clinical prescriptions. Further information on the radiation doses of digital systems as well as CBCT equivalence to conventional exams (periapical and interproximal radiographs) and other digital techniques, such as panoramic radiography and FBCT, is needed. Additionally, the respondents showed lack of knowledge of the processing, storage and care of radiographic examinations, which might be somewhat disturbing as it is highly important that dental professionals be aware of the film sensitivity used in their clinical practice. Finally, it is important to highlight the use of lead aprons as well as thyroid collars for patient protection since the gland in question is one of the most radiation-sensitive parts of the body.

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